IN THE SPECIFICATION:

On page 1, before line 3 and after the title, please insert the following headings, and thereafter amend the first paragraph which begins on line 3, as follows:

--BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

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The present invention relates to a torque-limiting coupling device ~~of the kind defined in the preamble of Claim 1~~ having two coaxial, generally cylindrical co-acting surfaces on two co-acting parts in the form of a cylindrical sleeve and a cylindrical shaft, respectively. The sleeve is in frictional engagement with the shaft for transmission of torque up to a limit that corresponds to the frictional engagement and at which the sleeve begins to rotate relative to the shaft. The device further includes a pump mechanism which, upon relative rotation between the sleeve and the shaft, is driven to pump liquid to an interface between the co-acting surfaces, with channels being provided to carry away liquid from the interface so as to restore the frictional grip after the torque limit has been exceeded.--

On page 1, line 5, please insert the following heading:

B3 --2. DESCRIPTION OF THE RELATED ART--.

On page 1, please amend the second, third and fourth paragraphs, which begin on line 6, as follows:

--A coupling device of the kind in question is disclosed in WO 90/00231, which corresponds with U.S. Patent No. 5,069,320. This known device generally functions well. Devices of this kind are often used in steel rolling mills between a drive motor, for instance an electric motor, and a roll. The power transferred may be in the order of 20,000 kW. Idling costs in respect of such a rolling mill may lie in the order of up to 100,000 Swedish kroners (SEK)/hour ~~SEK/hour~~.

In the case of the areas of use concerned, the device is triggered with a relatively low frequency, for instance a frequency in the region of once every five years to up to 300 times annually. A typical activating frequency is twenty times per annum.

Basically, the coupling device comprises two axially, generally cylindrical interacting surfaces on two interacting parts in the form of a cylindrical sleeve and a cylindrical shaft respectively, wherein the sleeve is in a torque-transmitting frictional contact with the shaft for transmission of torque up

to a corresponding limit, after which the sleeve begins to slide or slip relative to the shaft. The frictional engagement can be adjusted to a selective level with the aid of some suitable technique. For instance, the sleeve may include a concentric ring-chamber that can be placed under pressure. The coupling device includes one or more pumps that function to pump liquid from a liquid store to the gap between the interacting surfaces, such that the liquid will form a hydrostatic layer together with said interacting surfaces. The pumps are intended to be driven by relative rotation between said parts. As a result of pumping liquid in between the mutually co-acting surfaces, said surfaces are able to slide relative to one another as soon as ~~immediately~~ the set torque is exceeded. This enables damage to the coupling device and to the motor or rolling mill to be avoided. A torque-limiting coupling device of this known kind need only rotate through barely one revolution in order to generate an hydrostatic layer for which the torque is reduced to a level close to zero.--

On page 2, please amend the second and third full paragraphs, which begin on line 7, as follows:

--Problems associated with this known device reside in the possibility of all or part of the liquid/oil contained in the device leaking away before the device is triggered, or <u>of</u> ~~caused by~~ a change in the properties of the oil with time, contamination of the oil with particles that can be formed, for instance, in conjunction with triggering the device and that clog valves, filters, and disturb or interfere with the function of the device, and so on.

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There is therefore a certain risk that this known device will malfunction when triggered. Malfunctioning of the device would mean that the mutually interacting surfaces would not be separated sufficiently and that insufficient oil would be pressed in between the interacting surfaces. The malfunction may then cause a very high torque to be transferred via the device in spite of ~~everything else~~ <u>the torque-limiting mechanism</u>, therewith resulting in damage to the motor and driven equipment for instance, and also such as to cause serious damage to the coupling device itself. Particularly with a view to the consequence of such a malfunction (compare the idling cost), the type of device concerned has not found particularly wide use in practice, despite the ability of the device to enable automatic and fast resetting with normal triggering of the device, and

B5 thereby a fast return to plant operation after having removed or rectified the triggering cause.--

On page 2, line 24, please insert the following heading:

B6 --SUMMARY OF THE INVENTION--.

On page 2, please amend the fifth and sixth full paragraphs which begin on line 31, as follows:

B7 --This object is achieved with a device ~~according to claim 1~~ having two coaxial, generally cylindrical co-acting surfaces on two co-acting parts in the form of a cylindrical sleeve and a cylindrical shaft, respectively. The sleeve is in frictional engagement with the shaft for transmission of torque up to a limit that corresponds to the frictional engagement and at which the sleeve begins to rotate relative to the shaft. One of the co-acting parts has a base with an outer surface layer thereon which defines one of the co-acting surfaces which is made of a material that has a plasticizing limit which is lower than the plasticizing limit of the material in the co-acting surface of the other part. The device further includes a pump mechanism which, upon relative rotation between the sleeve and the shaft,

B7

is driven to pump liquid to an interface between the co-acting surfaces, with channels being provided to carry away liquid from the interface so as to restore the frictional grip after the torque limit has been exceeded.

~~Further~~ In further embodiments of the device, ~~will be apparent from the accompanying dependent Claims~~ the outer surface layer includes cavities which enable the surface layer to move away from the co-acting surface of the other part upon plasticization. These cavities may consist of grooves disposed around the circumference of the outer surface layer. The outer surface layer may be made of tombak, while the other co-acting surface is made of steel, and the co-acting parts may be mutually tensioned radially in order to establish the frictional grip between them.

In addition, according to further embodiments of the device, the outer surface layer may include cavities which allow the surface layer to take a radial thickness that is smaller than the radial distance between the surface of the base and the co-acting surface of the other part subsequent to plasticization of the surface layer and radially relieving the co-acting parts of load. The co-acting surfaces may further be comprised of a

B7

material whose coefficient of thermal expansion is higher than the coefficient of thermal expansion of the base.--

On page 4, please amend the second full paragraph which begins on line 7, as follows:

--The coupling can be readily renovated subsequent to plasticization ~~(melting~~ (which may lead to melting of the surface layer), by heating said layer and that part (the shaft) that carries the surface layer. Because the surface layer is comprised of material (tombak) that has a high coefficient of thermal expansion, the layer will loosen from the base of said part (the shaft) and be easily drawn off the shaft. A replacement surface layer in the form of a tombak-sleeve can be simply inserted into/pushed over the part concerned (10, 20) and fastened thereto by means of a glue joint, for instance, this joint being destroyed by the heat applied in the renovating process or in conjunction with plasticization of the surface layer.--

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On page 4, line 15, insert the following heading,

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--BRIEF DESCRIPTION OF THE DRAWINGS--.

On page 4, line 20, insert the following heading, --DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS--, and after the heading, insert the following paragraph:

--Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.---.

On page 4, please amend the fifth and sixth full paragraphs, which begin on line 21, as follows:

--The device illustrated in Figure 1 is based fundamentally on the device according to ~~WO 90/00231~~ U.S. Patent No. 5,069,320 to Falk, the teachings of which are hereby incorporated in this document by reference as if fully set forth herein.

The coupling device basically comprises a cylindrical trunnion 10 and a sleeve 20 that embraces the trunnion/shaft 10, said shaft 10 and sleeve 20 having ~~have~~ respective flange

connections 11 and 21 for connecting up a drive system, for instance a large electric motor and a roll belonging to a steel rolling mill. The sleeve 20 has an inner surface 22 that co-acts with an outer surface 12 on the shaft 10. There is included in the sleeve wall an oil chamber A that can be placed under pressure by ~~pumping-in~~ pumping in oil at a pressure, e.g., in the range of 0-50 mPa, to cause frictional engagement at the interface B between the mutually co-acting surfaces 12, 22. The frictional grip and the maximum torque that can be transferred are determined by the oil pressure in the chamber A. After pumping oil into the chamber A via a filling channel (not shown), a valve (not shown) in the channel ~~(not shown)~~ is closed.--

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On page 5, please amend the first and second paragraphs, which begin on line 1, as well as the first and second full paragraphs on page 6, as follows:

--The cylindrical sleeve part 20 includes a hub 30 which is mounted for rotation co-axially with the sleeve part 20. The hub 30 carries on its outside a bearing 5 which is eccentric with respect to the hub axle. A number of oil pumps 3 operate radially between the bearing 5 and an inner surface of said sleeve part. The pumps have associated channels 4 through which

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oil is pumped to the interface B, for instance to its longitudinal ~~centre~~ center region. The oil spreads along the interface and can, for instance, be collected-up via a channel 41 at one end of the interface B and returned to the pump space. A quantity of oil may be enclosed internally in the pump space, so as to be sucked up by respective pumps immediately and pressed out to the interface B upon relative rotation between the parts 10, 20. The pumps ~~5~~ 3 will be set into operation upon such relative rotation, owing to the eccentricity of the outer surface of the hub 30 (the eccentric position of the bearing 5 relative to the parts 10, 20). The ~~part~~ outer surface 12 of the shaft 10 that co-acts with the sleeve 20 has a surface layer 50 of tombak (90% Cu, 10% Sn, 1% Pb). The layer 50 has grooves 51 in its free main surface. The grooves 51 may also be ~~utilised~~ utilized as oil distributing channels for distributing oil from the pumps 3. Oil is pumped from the pump 3 to the longitudinal center ~~centre~~ region of the interface B, via the channel ~~40~~ 4, and flows from there axially to both ends of the interface B, as shown by the arrows in the Figure. A flow of oil is transferred directly back to the pump chamber~~, and an oil part-flow is~~ when collected via the channel 41 extending back to the oil pump chamber.

B12

~~There is located~~ The space between the shaft 10 and the sleeve 20 ~~a space which~~ is essentially filled ~~completely~~ by the layer 50, with the exception of the grooves 51 in said layer. The grooves 51 also serve to receive parts of the layer 50 that are plasticized as a result of relative rotation between the parts 10, 20. The surface 22 of the sleeve part 20 is comprised of steel and co-acts with the tombak surface of the layer 50. The tombak layer 50 is able to transfer the torque at normal torque. However, when the torque load exceeds the pre-set value, the steel surface 22 will begin to slide relative to the tombak layer 50. The friction heat and/or the relative movement causes the layer 50 to deform rapidly, as a result of plasticization or melting. The grooves 51 enable the material in the surface of the layer 50 to be displaced radially in a direction away from the surface 22. Subsequent to the sleeve and shaft having been thus relieved of load in the radial direction, and in view of the state and temperature of the deformed surface layer 50, the~~The~~ net volume of the layer should be accommodated appropriately in the space between the sleeve and the shaft~~, subsequent to the sleeve and shaft having been relieved of load in a radial direction and in view of the state and temperature of the deformed surface layer~~. This reduces the risk of the material of

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layer 50 receiving so much energy as to cause ~~the~~ such material to actually melt. The plasticization results in a successive reduction in the liquid limit of the material, i.e., that point at which the material will turn to a liquid. Normally, in the absence of excessive plasticization or temperature, the material of layer 50 will not pass into a molten phase. As a result of plasticization of the material 50 and the displacement of said material, the power transmission between the parts 10, 20 will be limited even if the pumps 3 are not able to pump oil into the interface B.

B12

The frictional engagement between the shaft and the sleeve can, of course, be established with means other than pressurising the hydraulic chamber A as in the illustrated embodiment. For instance, the sleeve and the shaft may be conical and driven axially together so as to achieve a chosen frictional grip, i.e. a chosen upper torque transmission limit. When the sleeve and the shaft have pre-selected dimensions to achieve a given frictional grip, the grip can be achieved by so-called heat shrinkage or by press-fitting the sleeve to the shaft. When the frictional grip is eliminated, i.e. when the radial stress between shaft and sleeve is removed, the outer diameter of the shaft will increase and the inner diameter of the

sleeve will decrease. The outer layer should therefore be dimensioned so that its net volume can be accommodated, with a given margin, in the space between the sleeve and the shaft when the friction joint has been eliminated, i.e. when the load on the sleeve and the shaft has been removed radially. Thus, by forming the outer layer 50 with a material that has a relatively low plasticizing limit, it is possible to trigger an initial rotation between the parts 10, 20 in the absence of an oil film therebetween, at a relatively low torque limit that, nevertheless, lies above the torque limit established by the friction grip between the parts 10, 20 as a result of the initial plasticization of the surface layer material. The material of layer 50 can be said to form a lubricant in the interface between shaft and sleeve. When ensuring that the surface layer can be accommodated in the resultant gap between sleeve and shaft after having relieved the same of load in a radial direction, the transfer of energy to the material of the layer 50 is ~~minimised~~ minimized, as is also the transmission of energy between the shaft and the sleeve.

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In order for the surface layer to be able initially to transfer energy between said two parts, on the one hand, and to collapse and take a state of ~~considerable~~ considerably smaller

radial thickness, on the other hand, the outer layer may also include other recesses or hollows additional to the functional grooves on its free surface, for instance pores or the like, in its initial state.--

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On page 6, after the last line, please insert the following paragraph:

--The invention being thus described, it will be apparent that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be recognized by one skilled in the art are intended to be included within the scope of the following claims.--.

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